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THE

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PROCEEDINGS OF THE MEETING OF THE WESTERN PSYCHOLOGICAL ASSOCIATION, STANFORD UNIVERSITY, AUGUST 3 AND 4, 1928

Report of the Secretary, WARNER BROWN, *University of California*

The eighth annual meeting of the Western Psychological Association was held at Stanford University, August 3 and 4, 1928. About one hundred and twenty persons were in attendance.

After the annual dinner the retiring President, Doctor Shepherd Ivory Franz, read an address on "Observations on Aphasia."

The officers elected for the ensuing year were: Warner Brown, President; H. R. Crosland, Vice-President; Paul Farnsworth, Secretary-Treasurer.

ABSTRACTS OF PAPERS

The Maze Learning Ability of Anosmic and Blind-Anosmic White Rats. STANLEY B. LINDLEY, Stanford University. (Introduced by Calvin P. Stone.)

This is an experimental study of the maze learning ability of albino rats which were deprived of the sense of vision and the sense of smell. The instrument of measurement used was a Multiple-T maze. One hundred animals composed the control and experimental groups of which there were fifteen blind and anosmic, twenty-five anosmic, and ten partially anosmic animals. Control groups of blind and normal rats were tested in a manner similar to that of the anosmics and their maze records plotted against those of the anosmic animals. Anosmia was verified by post-mortem dissection. Rats which were both blind and anosmic showed by their maze records that they were at a greater disadvantage than the anosmic, and these, in turn, were less efficient learners than the partially anosmic. All anosmic animals were inferior to the blind and normal groups.

A Further Study of the Discrimination of Maze Patterns by the Rat. JOSEPH G. YOSHIOKA, University of California.

In the preliminary study the rat was found to discriminate between triangular and pentagonal paths of equal length, and to prefer the pentagon to the triangle. The pentagonal path so discriminated and preferred happened to lie on the right side, the triangular one on the left. Perhaps a mere position habit of going toward the right or left may have resulted in the preference of one path to the other. In order to clear up this suspicion a new group of 30 rats was made to choose between two triangular paths parallel all the way through under similar conditions. The mean of the choice of the right path in 60 choices for each rat was found to be 29.13 ± 2.57, a close approximation to the theoretical mean of 30. Hence the preference shown in the preliminary study could not have been due to a mere position habit. In order to see what other maze patterns can be discriminated several groups, each consisting of 30 rats, were given choice of two paths equal in length but of different shape. Exp. I cited above was used as a control to compare the results. The following facts were found: Exp. II was 3 vs. 5 side discrimination in a different setting. The pentagonal path here diverged from the triangular one on the second side, instead of the first side as in the preliminary study, of the triangle. The rats again preferred the pentagon. The critical ratio between the mean of the choice of the pentagon and the mean of the control was 2.09. Exp. III was 3 vs. 9 side discrimination; the critical ratio was 2.33 in favor of the nonagon. These two critical ratios are about the same, hence we should expect no preference between a pentagon and nonagon. This expectation was found to be true in Exp. IV which was 5 vs. 9 side discrimination. Here the critical ratio was only 0.31 in favor of the nonagon. Exp. V was 3 vs. 17 side discrimination; the critical ratio was 1.52 in favor of the heptadecagon. Comparing the two critical ratios in Exp. II and V, we should expect little preference between a pentagon and heptadecagon. This was found to be true in Exp. VI which was 5 vs. 17 side discrimination. The critical ratio found was only 0.81. Exp. VII was also 3 vs. 5 side discrimination where the pentagon was made by cutting a notch at one vertex of the triangle. The pentagon No. 2 thus formed then differed from the triangle as little as possible. Under this condition the rats still preferred the pentagon, the critical ratio being 1.62 in favor of the pentagon No. 2. For a crucial test Exp. VIII was carried out, where

the rats were given choice between two triangular paths parallel all the way through as Exp. I. And the rats that would choose these two paths 50–50 were collected. Thirty such rats were obtained out of 157. These selected 30 were then given choice between a triangle and the pentagon No. 2. The rats that showed no preference when the two paths were identical preferred the pentagon No. 2, the critical ratio reaching as high as 2.49. Hence it is concluded that the rat is able to discriminate maze patterns, and prefers in general a more complicated pattern.

The Effect of Change of Reward on the Maze Performance of Rats. M. H. ELLIOTT, University of California. (Introduced by E. C. Tolman.)

Groups of approximately thirty rats were given one trial per day on a fourteen blind, multiple-T maze. Group A received sunflower seed as reward at the end of each trial for twenty days and showed a typical learning curve. Group B received a mixed food (modification of Steenbock) as reward for the first nine days and on the tenth day and thereafter received sunflower seed. Group C were thirsty and received water as reward at the end of the first nine trials. On the tenth and following days the rats of this group were hungry but not thirsty when put into the maze and they received the mixed food as reward.

The change from one food to another (Group B) caused an immediate and reliable increase in both time and error scores which continued over a period of a week and was not wholly attributable to the difference in reward value of the two foods.

The change from water to food (Group C) caused only a slight increase in average time and error scores for the group, on the day of the change and had no effect on succeeding days. Moreover the performance of two-thirds of the animals was not at all affected by the change.

The results as a whole do not seem to be consistent with any strict S-R conception of animal learning but rather to fit in with some Gestalt interpretation.

It is suggested that the maze performance of a rat at any particular stage of learning depends on a number of independent variables among which are: (1) the internal physiological condition of the animal (drive or motivation); (2) the reward-value or satisfyingness of the goal object on previous occasions; (3) what might be called the "knowledge" of the maze.

A Study of the Discriminatory Ability of Albino Rats by Means of a Triple-unit Inclined Plane Discrimination Apparatus. THEODORE C. RUCH, Stanford University. (Introduced by C. P. Stone.)

An apparatus in which alleys identical except for differences in inclination are to be discriminated has been developed in an effort to provide a method for studying the proprioceptive sensory capacities of albino rats. The apparatus has the advantage of furnishing results on three choices each trial, of providing quantitatively graded stimuli, and of permitting right and left alternation of cues. A group of rats were able to discriminate a difference of 10 degrees in inclination, and learned to do so in fewer trials than were required to learn a light discrimination problem. The reliability of scores varies depending on the method of computation, but in general the apparatus compares favorably with other animal learning apparatuses. The albino rats were able to discriminate very small differences in inclination. The least discriminable inclination difference was 4 degrees for 4 per cent of the group, 3 degrees for 35 per cent, 2 degrees for 48 per cent, and 1 degree for 13 per cent. The animals successfully discriminating 1 degree difference failed to make progress when the alleys were of the same inclination, indicating that cues apart from the inclination of the pathways are *not* an adequate basis for the habit.

An Analysis of Motor Skills. ROBERT HOLMES SEASHORE, National Research Council Fellow, Stanford University.

The methods of job analysis and personnel work depend upon adequate analysis and classification of the variables determining individual differences. In the field of motor skills five theories have been presented to account for the observed differences. A laboratory investigation of serial motor performances was arranged to study the interrelations and stability of these differences, and their relations to more complex skills such as athletics and music. A summary of these and previous results is presented with interpretations of the validity of the various theories and their bearings on personnel work.

A Four Stage Classification of the Red-Green Color Blind. SIBYL WALCUTT TERMAN, Stanford University. (Introdcued by W. R. Miles.)

A study of sixty cases of red-green color-blindness was made with the idea of finding out what colors were actually seen in cases

of widely varying severity. Colored papers chosen to represent the whole color sphere, rather than the spectrum, were used. It was found possible to rate each individual's color vision by assigning to each hue a rating of 1, 2, 3, or 4. An individual who was rated a 1 in a certain hue, saw that hue normally, while a 4 indicated that it was seen as pure gray. A 2 indicated that bright, saturated, colors of the hue were seen as the true hue, while light, dark, and unsaturated ones were seen as either blue or yellow, according to the side of the spectrum on which the hue is found. A 3 indicated that saturated colors were seen as blue or yellow, and the rest as gray. In the light of this classification, confusions made in each case became clear, and could be predicted in advance. Each case was found to offer its own peculiarities which made a separate rating for each hue necessary. Divisions of the color blind into broad groups such as "deuteranopes" and "protanopes" is inadequate and misleading.

Teaching Bright, Average and Dull Preschool Children to Read. An Experimental Study. HELEN P. DAVIDSON, Stanford University. (Introduced by L. M. Terman.)

Purpose. The purpose of this experiment, which was carried out under the direction of Dr. L. M. Terman, was to find out (1) to what extent children with a mental age of four years could learn to read, and (2) whether bright, average and dull children, all with a mental age of four years, would learn to read equally well under the same experimental conditions.

Subjects. Three groups of children were used, *viz.*, five three-year-old, four four-year-old, and four five-year-old children. These had an average I.Q. of 128, 98.5, and 77, respectively.

Instruction. Each group met at a separate time for instruction. Each child was given a ten-minute reading lesson daily, while the group, as a whole, was usually given a brief group game in addition. Each group received somewhat less than 80 days of actual instruction.

Method. A special word-sentence method with some novel features was developed for this experiment.

Tests. Complete vocabulary and both standardized and unstandardized reading tests were given at regular intervals during the experiment, at its close, and after an interval of no instruction.

Results. Only a few of the results will be touched on here.

1. There were large individual differences.
2. The young bright children were undeniably superior to the other groups.

3. The average group did slightly better than the dull group.
4. At the close of the experiment the average number of words recognized out of context by each group was as follows:

Bright group	129.4
Average group	55.8
Dull group	40.25

5. Two of the three-year-old children, after less than one term of instruction, were able to read as well as the average first grade child after two terms of instruction.
6. The eye movements of our most successful three-year-old subject (photographed by Dr. W. R. Miles), equalled those of third grade children in silent readnig (Buswell's norms).

The Influence of Reading Direction and Character Position Upon the Speed of Reading Chinese by Means of a New Quadrant Tachistoscope. SIEGEN K. CHOU, Stanford University. (Introduced by W. R. Miles.)

A number of researches have been done in the United States by Chinese researchers on the problem of vertical and horizontal reading of the Chinese language and all results tend to favor the vertical. The rôle of habit and training in the traditional vertical reading has to be taken at its face value unless the experiment is on very young school children extending a very long period of time. This influence of habit and training is demonstrated by reading in four directions (upward and downward in the vertical, rightward and leftward in the horizontal) and by the use of four positions of seven Chinese characters of sense, upright, up-side-down, tilted to the right, and tilted to the left, exposed voluntarily in a new Quadrant Tachistoscope whose quadrant shutters permit opening either in the vertical or in the horizontal by electrical control. A new card-changing and card-releasing mechanism adaptable for all exposure apparatus makes possible a maximum number of exposures of 128 cards in as short a time as 25 minutes. Eleven Chinese subjects were used.

(1) By altering jointly the position of characters and the direction of reading, the speed of reading Chinese is impaired only 19.6 per cent in the greatest. This is when leftward reading of upright characters is changed to rightward reading of characters that are up-side-down. The change from the normal downward reading of upright characters to the latter is even less, being only 16.7 per cent. (2) Positions of characters is a more important factor in determining

the speed of reading Chinese than the direction of reading. When the latter affects the speed at all, it affects only by virtue of the temporal-spacial sequence (Gestalt?) created through the interaction between it and character position, which is the most important conditioning factor.

Maze Learning With the Time Factor Held Constant. RICHARD W. HUSBAND, Stanford University. (Introduced by W. R. Miles.)

The fact of maze scores being reported in terms of three variables rather than one causes confusion in giving conclusions, such as comparing two groups. Human subjects introduce a further difficulty in comparison by adopting such radically different modes of solution that group variations are very high. Accordingly, to eliminate the time variable, and in the hope that the group would become more homogeneous through being forced into more nearly the same methods of learning, twenty subjects were required to learn a maze pattern following the beat of a metronome, thus making all subjects do each trial in the same and equal times. The results are compared with those of an equal control group performing the same act except that the metronome was omitted. A few more trials were necessary, due to the distracting influence of the metronome. The relative variability was not reduced. The methods of learning, however, were more in agreement, tending toward the motor type. The shapes of learning curves are very similar for both groups. The errors correspond somewhat more to those made by subjects in the control group who used a motor method.

The Maze Learning Ability of Blind Compared With Sighted Children. JOSEPHINE R. KNOTTS and W. R. MILES, Stanford University.

There are conflicting results regarding the relative sensitivity of blind and sighted individuals. A practical performance that involves sensitivity in its natural combination with learning is the maze test. Since the blind use the fingers for direct contact, a maze which is to be traced out with the finger would seem to be especially appropriate for them. The high relief type of maze serves this purpose and may be contrasted with a stylus maze of the same pattern. The mazes used were of multiple-T construction in the design known as Warden (Pattern II). Forty students, 16 girls and 24 boys, from the California School for the Blind, Berkeley, were studied in com-

parison with 40 students matched in age and intelligence from the Palo Alto High School.

Each maze contained 10 consecutive choices. For the stylus maze the median number of trials for the blind was 56, for the sighted 76. The same comparison for the finger maze shows the blind with 33 and the sighted with 35 trials. The blind grasp the pattern of the high relief maze more readily than in the form of a stylus maze, but the median scores show that they are not inferior to the sighted subjects when tested on the stylus maze. Our results confirm those of Koch if these are also interpreted on the basis of median scores. The blind as a group thus demonstrate no handicap in maze learning.

Follow-up Test Program With a Thousand California Gifted Children. BARBARA S. BURKS, Stanford University. (Introduced by L. M. Terman.)

This year a grant from the Commonwealth Fund has made it possible to investigate the present status of the members of the group of gifted children located and studied six years ago by Professor Terman and his staff. Since the original survey we have kept in touch with the general development of the children in the group incidentally through personal contact and correspondence, and systematically through two follow-up questionnaires that have been filled out by the parents, and one filled out by the schools attended by the children.

The follow-up schedule this year is more comprehensive. The schedule has included a field worker's home conference, school conference, and, in most cases, conference with the child himself. Parents, teachers, and children have filled out questionnaire blanks aggregating twelve pages. A battery of intelligence tests, achievement tests, and personality tests have been administered. Detailed pictures have thus been obtained of the children's functioning,—mental, moral, social, educational, vocational, avocational.

Since much of our material has not yet been worked up into wieldy form, this paper deals only with the *test* data obtained, and summarizes our returns from the following tests: *Intelligence Tests,* Stanford-Binet, Herring-Binet, Terman Group Test; *Achievement Tests,* Stanford Achievement, Iowa High School Content, Hotz Algebra scales, Burch Literary Comprehension; *Personality Tests,* Washington Social Intelligence, Woodworth-Cady, Wyman Interest, Watson Fairmindedness, Masculinity-Femininity.

Concerning So-Called Group Effects. PAUL R. FARNSWORTH, Stanford University.

Groups of subjects varying in number from 20 to 36 were given easy and difficult "intelligence" tests under two conditions,—in isolation and in the presence of groups. The subjects were paired into two groups on the basis of the Thorndike test or form A of the tests in question. No consistent group effect in mean scores, items omitted, attempted or attempted minus omitted was visible. There was a slight tendency for students working alone to obtain higher scores (miss less) on the more difficult items.

How Are Sounds Localized? PAUL THOMAS YOUNG, University of Illinois.

Current theories assume that sound localization depends upon some physical difference between the stimulation of right and left ears. Experiments with a reversing pseudophone show that present theories do not go far enough. When right and left ears are acoustically interchanged normal sound localization is possible provided the subject can see the source or attend to its position. Experiments show that localization is a function of the total organism involving a neuromuscular adjustment towards a source or towards a situation. This adjustment may be made via the ear or via the eye. The adjustment involves changes in the pattern of muscle tonus.

Results of Vocational Interest Test Upon College Students. EDWARD K. STRONG, JR., Stanford University.

The test was given to nearly 300 Stanford seniors of last year. The following topics were discussed: relationship of score on the test to (a) choice of occupation, (b) general intelligence, (c) scholarship, (d) scholarship in particular subjects, as engineering, (e) number of units elected in particular subjects.

The Need of the Psychology of School Subjects. HOMER B. REED, University of Pittsburgh.

Courses in general educational psychology are usually ineffective for the improvement of teaching. The reasons are that in teaching we have a specific subject matter which can only be learned under certain conditions by an individual learner, but in the study of general educational psychology, the teacher acquires learning, and these cannot be applied to a specific situation without much modification. To improve the teaching process the teacher must know

what modifications to make for different subject matters and for learners of different age and mental levels. What these modifications are cannot be deducted from the general principles of learning but must be worked out experimentally for each subject and grade. A few illustrations will make this clear. It is generally agreed that repetition is a law of learning and that improvement increases with the amount of repetition, yet experiments have shown that third grade children do worse after five repetitions of the words of a spelling lesson than after two repetitions. Another principle of learning is that improvement is increased by distributing the repetitions, but the extent to which practice should be distributed depends on the subject matter and on the age and ability of the learner. Practice periods two minutes long are profitable for teaching arithmetic combinations in the third grade, but in the upper grades drill periods may well be ten or fifteen minutes long. In teaching reasoning problems one weekly period fifteen minutes long was found to be better than five five-minute periods. The use of a logical procedure is another factor that usually helps the learning process. This is true in solving reasoning problems but it is not true in learning to spell. What is true of these principles of learning is true of others. Their application must be worked out experimentally for each subject matter and grade, and this is the function of the psychology of school subjects.

Some Principles of Mental Hygiene Research. E. A. Bott, University of Toronto.

Various conceptions are held today regarding what Mental Hygiene Study means and what relation, if any, it has to a scientific psychology. Historically the outlook of mental hygiene has undergone radical changes; at present it not merely seeks a sound psychological foundation but in so doing raises the question of what contribution our current psychological science has to offer towards the fundamental problems of preservation of normal mental health.

The changes in conception concerning mental health problems have paralleled those developed for physical health. Restricted for centuries to the more extreme conditions and therapeutic measures therefor, an advance first came in seeking a fuller *natural history* of how such clinical conditions had developed in each individual case. This backward or mental post-mortem plan of study then came to be applied of the individual in the forward-looking direction, beginning early with the first signs of maladjustment and utilizing direct

observation to follow the developing condition through its various stages in the life of the individual. This clinical conception gave rise to an important methodological principle, namely, the intensive *longitudinal* study of the adjustment processes of the individual; the objective, however, was still clinical and in the main ameliorative, *i.e.*, the study was directed upon special abnormalities of adjustment with a view to effecting an improvement of adjustment.

A further change of conception along these lines is evident today, and offers both an inspiration and a challenge to modern psychology. Abnormal adjustment, so-called, is merely a matter of degree by way of excess or defect; importance attached to such conditions is on extraneous rather than scientific grounds; the broader and more basic objective for longitudinal study of the individual includes the study of *all behavior* through *all stages* of the life span.

This genetic conception of longitudinal investigation offers an inviting program for modern psychology. The outlook must be intensively and empirically ontogenetic and likewise phylogenetic and comparative. It will force us, of necessity, beyond the confines of the conventional laboratory and clinic, to study at first hand the phenomena of adjustment where they actually occur, in the home, the school or the workshop. It will emphasize actual analysis of these complex situations and a consecutive record of their continual change, rather than merely diagnostic "testing" of the individual with appeal to statistical procedures as a basis for interpreting present performance upon tests.

As yet psychology has not a great deal to offer in terms of general principles derived from epirical longitudinal studies of life adjustment of normal individuals comparatively considered. The recent beginnings upon the infancy stage and preschool years must be extended to encompass all stages of life. Research alone can reveal *norms* of adjustment at all such levels which will be constructively useful for those whose business it is to deal with significant deviations in the behavior of individuals. Science and service are here as distinct but as correlative as in other fields of inquiry.

To illustrate the possibility of conducting longitudinal studies at various life stages by means of a university personnel reference was made to contacts which have been developed at Toronto in a local Mental Hygiene Research Division extending over the past four years. Data upon the sleeping habits of young children were presented, as one phase of a series of preliminary studies appearing in Vol. IV, No. 1 of the *Genetic Psychology Monographs.*

The Eyeball's Shifting Center of Rotation. W. R. MILES, Stanford University.

Beginning with the work of J. Müller in 1826, the center of rotation for the eye has been a subject of no little investigation. It is played upon by a complex muscular system. Most of the measurements have been made considering the eye as moving in the horizontal plane. Valentine in 1844 made measurements for both horizontal and vertical movements and came to the conclusion that for the vertical movements the center of rotation was about 1 mm. nearer the apex of the cornea, nevertheless the center is usually described as one point for all axes. In eye movement studies at Stanford using the photographic method of recording from a sharp reflected image on the cornea we have found that the eye movements, that is, of the *apex of the cornea* in the vertical are characteristically smaller for a given distance of visual arc, say 40 degrees, than the movements in the horizontal.

It may be shown that this effect is not due to the shape of the cornea. By using an enlarging camera as a camera-lucida and marking on a glass plate the successive positions of the *border of the cornea* when the eye is looking at the different fixation points we get a result similar to the photographic record. When the internal and external recti move the eye in the horizontal axis the other muscles are somewhat active and tend to serve as fixation muscles. Similarly when the eye is elevated and depressed the internal and external recti take the rôle of fixation muscles. If we note the positions of insertion for all these muscles it is obvious that the internal and external recti will hold the globe from a point anterior to that which would be the center of the holding position when the oblique muscles are active in this capacity.

When we compare the horizontal with the vertical axis for the eyeball, the cornea, the fovea, the separation of the eyelids (palpebral fissure) and as shown in this paper for the amplitude of corneal movement, we see that in each instance the horizontal axis is somewhat greater than the vertical.

Deadening Docility and Superstition in the Lecture Hall. J. E. COOVER, Stanford University.

Current evidence of a deadening docility in the lecture hall that blocks the educative process is presented in the failure of students to appropriate answers within their reach to questions that arouse

their curiosity and that are frequently put to them. It is found also in their failure to apply clearly understood psychological principles to important problems in psychical research, such as (1) honest mediums and (2) sincere testimony for the supernormal by competent and eminent men of science. They stoutly cling to the superstitions that all mediums are fraudulent; that eminent proponents of the supernormal have suffered a softening of the brain. The phenomenon here observed is probably prevalent in university instruction, and the mental attitude is in such violent contrast to that commonly regarded as characteristic of our "flaming youth" that speculation on its cause is aroused. Is it possible that a like docility and superstition on the other side of the desk have flattened out our youth with textbook instruction?

The Organization and Content of the Elementary Laboratory Course in Psychology. FRANKLIN FEARING, Northwestern University.

The object of this paper is to present some of the problems involved in the organization and content of the elemental laboratory course. The comments are based on the assumption that, in general, the elementary laboratory course in psychology as now given in most institutions is not satisfactory either to student or teacher. The "lecture-demonstration" and "demonstration-laboratory" systems now in vogue in many institutions are an inadequate compromise so far as the training of students in experimental psychology is concerned. The following propositions are discussed: (1) The chief aim of elementary laboratory instruction is to introduce the student to the experimental method rather than to teach a body of facts or principles. (2) The distinction is made between *information about* and *knowledge of* a subject. The former is represented by the lecture and demonstration method and the latter by the laboratory method of instruction. (3) Suggestions are offered as to how the experiment may be presented to the student in order that the chief features of the experimental method may be exemplified.

Do Natural Units of Mental Measurement Exist? TRUMAN L. KELLEY, Stanford University.

It is argued that in the physical sciences natural units of length, weight, time, etc., do exist, but that they vary dependent upon the issue involved. Similarly, a natural unit for the purpose of measuring environmental changes would not be the same as a natural unit

for the purpose of measuring hereditary influences, or mere mental maturation. Our present mental units are unknown functions of these two jointly, and are thus unsatisfactory for the measurement of either separately. We may, however, reweight our present units of measurement in a first manner so as to yield measures of heredity, contaminated as little as may be by environment, and in a second manner so as to yield measures of environment, contaminated as little as may be by heredity, and thus approximate scales of measurement of the nurture and nature factors separately.

Maturation and Exercise. R. S. WOODWORTH, Columbia University.

The Rôle of Repetition in the Formation and Dissolution of Habits. KNIGHT DUNLAP, Johns Hopkins University.

A REVIEW OF RECENT EXPERIMENTAL RESULTS RELEVANT TO THE STUDY OF INDIVIDUAL ACCIDENT SUSCEPTIBILITY

BY E. E. BRAKEMAN AND C. S. SLOCOMBE

Boston Elevated Railway, Boston, Mass.

A railway company controlling transportation by subway, street car, and bus of a million passengers per day discovered on investigation among its operators a certain proportion who were particularly liable to have accidents. Having so concluded, it proposes in the first instance to determine the individual limitations leading to accidents with a view of adopting appropriate remedial measures in the case of men in its employ. It hopes also to select its new employees in the light of its more scientific understanding of the qualifications necessary in its work. As an essential in the accurate diagnosis of individual accident proneness, it proposes to institute a laboratory of applied psychology, specifically designed to isolate significant limiting functions.

An extensive study of all relevant results so far obtained by experimental psychology was considered basal to the design of the laboratory. These results necessarily require very careful interpretation in their application to specific circumstances. The literature has been thoroughly reviewed under five headings, vision, reaction time, fatigue, attention, kinaesthetics. It is expected that this review will stimulate a wider interest in industrial psychology and hoped that such increasing interest on the part of psychologists may help the subject along the distant road to scientific status.

Vision

In the consideration of vision as one of the limiting factors in industrial efficiency, it is well at the outset to clearly differentiate from a psychological point of view the aspects of vision.

From published articles by Spearman (**73**), Harford (**76**), and Oberly (**59**), three stages may be regarded.

(a) The response of the retina to a stimulus, which would perhaps have been termed the sensation.

(b) The increasing "cognitive intensity" which brings the object away from its background and leads to its recognition.

(3) The increasing "determinateness" which grows with but lags behind (b).

The discussion which follows concerns itself mainly with the first and third stages. The second is too much dependent on factors other than the effectiveness of the visual apparatus to be capable of accurate description.

It may be said at the outset that limitations of vision common to all as well as individual differences are of interest to the industrial psychologist. In the experimental work on vision, not very much attention has been paid to these differences. The limitations in which the differences found are very small or non-existent are as important as those in which they are large. In one case the measures adopted to secure greater efficiency and safety must be entirely different from those applied in the other. For in one case the problem must be tackled by modification of working conditions as a whole, while in general in the second case selection would probably have its effect.

Acuity has been found to be affected by age, darkness adaptation, brightness of background, contrast between that and test object, duration of exposure, brightness of pre-exposure, color of stimulus, portion of retina stimulated, movement of test object, flicker, disease, and fatigue.

Age. Sheard (**70**) found that acuity decreased somewhat with age, there being somewhat greater decrease for men than for women. The age at which it is at its maximum (somewhere in the early twenties) is not always particularly significant since most operating employees enter service later. However, owing to the decrease in acuity, there should be much more frequent tests for visual acuity of workers as they advance in age. Frequently older employees who are sent for sight examination are found to have developed defects seriously limiting their efficiency.

Background. In the consideration of this, the important factors are (a) brightness discrimination, (b) contrast, and (c) illumination.

In artificial illumination the object is to obtain a background that gives sufficient light without glare. Johnson (**47, 48**) has found that performance is greatly impaired when surroundings are of greater brightness than the test field. Adams and Cobb (**1**) on the other hand found loss of accuracy with too dark a surrounding field. According to Sheard (**70**) an increase of brightness of background up to 1 f.c. increases acuity very rapidly, but after that point very slowly. Banister, Hartridge, and Lythgoe (**2**) found an increase

in acuity with increase of background brightness up to 100 f.c. and after that no increase. Illumination of 2–4 f.c. these experimenters say is sufficient for ordinary work. Motormen are not doing fine work so a higher intensity of illumination is neither necessary nor desirable. But fatal accidents are sometimes caused by an operator's inability to see a person in dark clothes against a background of fairly low intensity until he is but a few feet away. Einthoven (**14**) believes that the ability to see a dark object on a light background depends upon brightness discrimination so that it is the ability of a motorman in this aspect that is significant.

Luckeish (**70**) found that yellow monochromatic light used as background was best in defining power and gave least change of visual acuity with change in brightness of test object. This is very important in the study of proper street lighting since test objects on the street are of highly varying intensity.

In this connection an experiment by Rand (**66**) who found different brightnesses of background had an after effect due to induction is rather interesting, since the background of the street both in day and night illumination is varying. Thus errors might result from induction. In regard to varying brightnesses of test object, Cobb (**9**) found that a relative increase in brightness could overcome lowered acuity caused by reduction in contrast or size of test object.

The background illumination in a motorman's experience is the street lighting, both daylight and artificial. His acuity is undoubtedly impaired by fog, rain, mist, etc. In such weather, contrast is very low. Such background is nonuniform, constantly moving, and varies greatly from day to day. At night the background can perhaps be more easily controlled. Holladay (**38**) found intermittent lighting most satisfactory for acuity. Mast and Dolley (**53**) also found the stimulating efficiency greater with intermittent than with continuous light except when dark intervals are very long when efficiency decreased. (Attention probably is a factor here.) On the street it is quite bright under lights and dark between them causing an intermittent effect, though it is doubtful whether his can have any effect other than increasing the attention. There are probably individual differences in brightness discrimination.

Duration of Exposure. Wever (**89**) found that good perception of form was directly proportional to the time of exposure. In cases of emergency the time of exposure is usually very short and therefore the figure ground perception is inaccurate or blurred. The object

coming within the line of vision very rapidly is not clearly apprehended in relation to the background. The reaction then is to somewhat undetermined stimuli.

The length of time required for the eye to apprehend an object varies directly with increase in difficulty, inversely as the log of the brightness, with intensity (Ferree and Rand (**18**)), visual angle (Geissler (**29**)), contrast, and size of test object, which can be overcome by increase in brightness (Cobb (**9**)).

It is the speed of apprehension not the thoroughness that is the primary concern since the street car operator does not have to see every detail of the street scene before him, but he must see things that appear very suddenly and realize whether they are significant as accident hazards.

After Images. These have been found to have an effect on quickly succeeding stimuli.

The duration of stimulus, not the position of fixation or rate of objective movement is the conditioning factor in after images. The after effect may cause pressure sensations in the head and qualitative temporal and spatial interference of visual sensations (**79**). A street car operator looking at a congested street filled with moving vehicles for some time would, therefore, find his ensuing visual sensations inaccurate in both time and space perception due to this after effect.

Factors in production of after effect of motion, according to Hunter (**42**), are retinal changes, association factors, and strains in ocular muscles. Eye muscle strains may also cause apparent movement of stationary parallel lines. These factors would cause an operator having closely watched a street for a long time to receive inaccurate sensations of the rail before him and the movement of the traffic.

Newhall and Dodge (**58**) said that negative after images resulted from unperceived colors. These after images were dependent on rate of introduction and withdrawal of stimulus. Thalman (**79**) found an after effect observable when the whole visual field was filled with a moving stimulus. The probable large individual differences in the effects of after images are worthy of much more study.

Peripheral Vision. When objects are directly in front of the operator, the foveal section of the retina responds to them, but when they are at either side or above or below the direct line of vision, the periphery must respond. Geissler (**29**) found that the time refurther out in peripheral regions. There were few inversions. He

quired for judgments of space increased as stimulation occurred also found there were more errors in the vertical diameter than in the horizontal. This is interesting in view of the fact that some workers have to discriminate objects above and below the line of vision as well as in a horizontal plane. If there is greater inaccuracy in vertical vision, this plane must be most carefully watched by the operator. Peripherally a motorman could not see a person on the street in front of his car (considerably below the level of his gaze) as well as someone about to walk into the car from the right or left. Since this condition cannot be controlled the operator should look down before starting his car rather than trusting to any peripheral perception in the lower portions of the retina, while glancing to the side.

Snell and Sterling (**72**) found that the geometric ratio of the visual efficiency of the eye varies inversely as the arithmetic ratio of the visual angle. Thus acuity decreases very rapidly as the angle increases.

Reaction to peripheral vision is discussed under reaction times.

Color. In peripheral vision, Ferree and Rand believe that the effect of change of intensity is marked on both size and shape of fields of sensitivity, and that the chromatic threshold of sensation decreases irregularly from center to periphery (**18**). They found that angular limits of color field were widest when pre-exposure and background were of same brightness as the color stimulus (except for small blue stimuli) (**21**). Variation in intensity from .03–51 f.c. gave changes in color field as follows: red, 11–37 degrees; blue, 13–37, and green, 10–19. (This is supposed to represent the change in illumination from 1:00 P.M. to 4:15 P.M. on a bright day) (**20**). Thus the blue and red color fields would be larger later in the day than the green. The factors found to influence sensitivity of retina to color were size, intensity, and brightness of stimulus, brightness of surrounding field, and general illumination (**58, 66, 74**).

Also the results obtained by Ferree and Rand (**19**) on absolute limits of color sensitivity are interesting. The far periphery of the retina was absolutely blind to green but not to red, blue or yellow. With stimuli of high intensity the limits for red, yellow, and blue coincided with those for white light vision; with stimuli of medium intensity (equal energy) the limits interlace; and with lower intensities, the limits are widely concentric. If these results are universally true and the conditions on the street give the same results as those

in the laboratory, an operator cannot see a green light at all when it is far from foveal vision. These experimenters have recently published results showing that a decrease in the size of the stimulus decreases the size of the color field but not in direct proportion. That is to say, a large object can be seen further out in the periphery than a small object of the same color.

In color illusion experiments by Warden and Flynn (**85**) it was found that the color weight illusion was greater than the color size illusion. Color weight illusions were due to intrinsic value of color but color size illusion was due to serial arrangement. Monroe (**57**) also did work on the apparent weight of color. Errors in judgment of size due to color of stimulus would seem therefore to be small.

Bills (**4**) found that the eye was not only selective in response to wave length but also in the lag in giving full response. Her results show too wide differences to allow of generalization and would indicate that the variations due to individual differences were very great. It is an interesting fact that there is more rapid increase in reaction time for green and blue than for red and yellow when the intensity of stimulus is decreased. If the results of such an experiment were conclusive and showed significant variations, they would be pertinent to subway operation. In view of the above statement, it is perhaps unfortunate that we use red for danger signals where action must be quickest and green to indicate a clear track ahead. This is, however, compensated for by the fact that red can be seen further out in the periphery than can green.

Adaptation. Distinct from the nerve tracts there are three functions of the eye in dark adaptation; pupillary adaptation, foveal and peripheral retinal adaptation. (The last would be, according to Hecht (**36**), the functioning of visual purple in the rods.)

The length of time required for the eye to become adapted to darkness is somewhat indefinite. Wynn Jones (**49**) finds 16 to 20 minutes long enough for dark adaptation to be completed sufficiently for testing. Since peripheral adaptation is from two to five times as long as foveal adaptation, objects on extreme right or left are not discernible as soon as those in direct line of vision. Adaptation may be hastened by an increase in intensity of stimulus. Travis (**82**) found that the longer dark adaptation went on, the lower the threshold of intensity. Rate of recovery from adaptation to darkness, Cobb (**8**) found in his work on problems of night flying, was directly proportional to the length of blinding. It did not always correspond to absolute threshold (limit of vision in dark adaptation). Individual differences in it were greater after longer blinding.

Ferree and Rand (22) found that the eye was inefficient in late hours of afternoon when artificial light was turned on due to previous adaptation to daylight. The work of Flugel (23) and Wynn Jones (49) on nyctopsis is interesting in this connection. They found that visual acuity in daylight was no criterion of light sensitivity in dim light or dark. Visual acuity in daylight correlates moderately with that in dim light which in turn correlates highly with that in much dimmer light. Sheard (70) found for average luminosities adaptation made no difference but for low luminosities acuity increased with darkness adaptation and just the reverse was true for high luminosities. The motorman being dependent to some extent upon daylight until late in the day must meet the problem of late afternoon twilight, poor street lighting, and subway tunnel darkness. He must also meet the problem of adjustment to rapidly varying intensities of illumination (at night generally, but during the day in entering and leaving subways). It is probable that there are large differences in ability to make at least partial adjustment to these conditions.

Movement. In the investigation of apparent movement De-Silva (13) is much concerned with the attitude of the observers. He found that right eyed observers seemed to initiate rotary movement in a counter clockwise direction from the vertical position. This might be a factor in the displacement of an object and misjudgment of distance. He found that perception of movement was affected in accuracy and speed by, (1) relative variation of stimulus and background, (2) point of fixation, (3) complexity of object, and (4) presence of meaning in the stimulus. In street car operator's work we find variations in all these conditions. There must then be apparent movements which could cause errors in judgment.

Vogt and Grant (84) maintain that apparent movement occurs more frequently when two stimuli are of the same color than when they are of different colors. Spearman (72) states that two retinal points presenting same visual situation can engender different visual situations, *i.e.*, the object may apparently move back and forth although retinal stimulation remains in the same place (convergence).

Thelin (80) experimented with two exposed lights varying in intensity, motion, and fixation. He found that when the dimmer light moved its apparent speed was increased but on the whole more accurate. When the brighter light moved, judgments of its movement were more inaccurate and it appeared to travel much slower than it actually did. When both lights were of medium intensity and only one moved at a time, judgment for both lights was less accurate

than when both were moved simultaneously. He also found that fixation induces mobility of the fixated. This is analagous to results in the experiments in reaction time with two colors, in which preference was always shown for fixated color (see below). Thus we find that variations in intensity and fixation affect perception of movement both in accuracy and speed.

Higginson (**37**) and Vogt and Grant (**84**) assert that the character of movement is dependent upon hue of the stimulus. Carr and Hardy (**6**) conclude that differences in size or increase in combined area of stimuli and higher rate of motion increased the accuracy of perception but that the extent of motion made no difference.

Thus (a) hue of stimulus, (b) inequality of brightness of stimuli, (c) point of fixation, (d) size of stimulus, and (e) rate of motion influence accurate perception of movement.

Perception of Distance. The enlargement of images in binocular vision is caused by failure of images to coincide perfectly. When a vertical line is viewed by two eyes separately the subjective images are not parallel (**67**). Howard (**41**) finds that both vertical and recti muscles function in convergence. This is manifested in the fact that an observer may see two lines instead of one, or one object may be above another.

Spearman (**76**) found that the depth sensation is produced by noncorresponding points when stimulation is in rapid succession and the apparent or perceived depth depends on degree of noncorrespondence between the two images. In view of these facts faulty convergence may interfere with the correct judgment of distance, which is so important to operation in traffic.

In perception of distance Smith (**71**) found the general tendency is to underestimation. In estimating length, men have a greater tendency to do this than women. Men seem to base their estimation on contrast, women on confluence. Granit (**30**) believes that perception of form can be divided into three factors: rectilinearity and curvature, magnitude, and direction. Pratt (**65**) found that angles were overestimated, acute being most accurate. She believes that the amount of space between the arms of an angle is not judged directly but with respect to imaginary lines. Individuals undoubtedly vary greatly in the method of judging distances and some are much better than others for reasons entirely apart from acuity. The introspective method only can assist in determining accurately these differences.

Visual Fatigue. It is generally stated that retinal fatigue rarely

enters consciousness and that what is felt is bodily fatigue causing retinal fatigue through nerve exhaustion (43), *i.e.*, it is mainly objective fatigue.

Monrad-Krohn (56) found that the stimulus must increase in direct proportion to fatigue to maintain the acuity. On the other hand a reduction in contrast delays the onset of fatigue (Jackson (43)).

Flugel (23) working on fatigue in reversible perspective found fatigue specific to perception of motion and to direction of movement. This specificity is in a way dangerous because a motorman must watch movement constantly. He may become fatigued in such a way that, though he can really see a moving object, he cannot correctly estimate its exact distance, or even its direction of movement.

Another alarming result of fatigue is an increase in after images (43), which as has been stated above causes considerable inaccuracy. The study of retinal fatigue, whether caused by bodily fatigue or not, is of great importance, particularly as the emergencies of railway operation necessitate a considerable amount of overtime.

Effect of Diseases. Acuity is affected by syphilis, Bright's disease, scarlet fever, diabetes, rheumatism, chronic intoxication, influenza, measles, diphtheria, affections of teeth, stomach or respiratory tract (64). Pfingst (61) found that hysteria affects vision centrally or peripherally for both color and form. The visual field is affected by cerebral syphillis, hydracephalus, tumors, and the pituitary gland. Workers who have just recovered from these diseases should have their eyes carefully tested before they are reinstated.

The effect of ductless (26) glands upon vision has been definitely ascertained. Fridenberg (26) believes that through the sympathetic system the glands affect the eye causing comparative hyperemia of the orbital tissues, lids, and conjunctiva, and vascular reactions of the iris and ciliary body (54). The glands that are of importance to the eye are the pituitary upon which seasonal diseases such as catarrh seems to depend; hypo- and hyperthyroidal, the latter causing glaucoma; and the gonads and adrenals. In the diminution of the visual field by the enlargement of the pituitary gland, Sharpey-Schafer (69) says the nerves of the eye are not permanently injured or destroyed since an operation will restore sight to normal. Gardiner (28) adds the pineal gland which he says, when it becomes enlarged, affects the color field but not the form field. He found the color fields were inverted but of normal size.

Reaction Times

Reactions may be considered from three points of view: speed, accuracy, regularity. The type of stimulus, simple or complex, and the specific reaction required, simple, choice, or complicated, might also be considered, but as the experimental work does not deal so fully with these conditions, their discussion, except incidentally is here omitted. Simple reactions to simple stimuli are of interest more as a theoretical basis of work. Choice reactions to complex stimuli would be of more practical value.

Speed and Accuracy. In experimenting with these two factors Hansen (34) found no correlation. Those who give accurate responses might have either quick or slow reaction times. In fact he found he could classify them into four groups, quick accurate, quick inaccurate, slow accurate, and slow inaccurate. Bernstein (3) found in working with certain reactions that coaching could not alter speed. The work of Thorndike and others is relevant here, in that it has been found that any improvement obtained in training (in what is really complex reactions) is specific to the particular reaction. In so far as there results are general there would have to be experiments specifically done on the various portions of an operator's work before the extent to which training can remedy initial defect in speed or accuracy of response could be determined.

In this work and most experimental work on improvement, there has been little consideration of physiological limits, which vary greatly between individuals and even at different times in the same person. There are numerous physiological factors affecting both speed and accuracy of response and especially variation in them. Visual acuity such as the perseveration of after images, temperamental and emotional differences tied up to glandular action and fatigue are some of the most important conditions. The variation of these in individuals probably cut across experimental data and make the results unreliable for general application or interpretation.

Reaction times are generally highly specific to conditions. A man who is quick and accurate in one reaction may be slow and inaccurate in another. Not only are responses to different stimuli uncorrelated but responses to a certain stimulus with distractions are different from that to the same stimulus without distractions. So not only the uniformity of physiological conditions of the subject but the stimulus itself must be very carefully controlled. In fact it is doubtful if any general assumptions as to reaction times in various phases

of a motorman's work can be made, but a certain individual's reaction to a particular stimulus or set of stimuli accurately determined would give definite and valuable information as to that individual's limitations.

In classifying the operators in terms of their speed and the number of accidents they had, regarding the latter as indications of inaccurate responses, it was found that they could be placed in the same four groups which Hansen has used. This, however, merely means that there is no correlation. On the other hand the form of distribution strongly suggested such grouping.

Regularity of Reaction is regarded by Lahy (**50**) as a more significant prognosticator of safe operation than speed or accuracy. This is most probably due to the fact that perseveration and oscillation are the factors measured by regularity. A certain amount of work on these factors has been done in the Psychological Laboratory of the University of London under Spearman (**51, 3, 75**) but the work requires corroboration and wider application before general acceptance. It suggests, however, certain possibilities which would be of great value in industrial psychology.

Physical Conditions. The reflex action of the muscles may be considered as a fundamental factor in all reactions involving bodily movement. Simple reaction tests which involve motion of hands, feet, or head should be helpful in indicating the speed and accuracy in a reaction that a man is capable of attaining. There will always be many variables here such as periodic changes in "fitness," relaxation, boredom, fatigue, emotional state, etc.

Jacobson (**45**) experimenting with the effect of a sudden expected stimulus found that muscular tonus played an important rôle. Subjects completely relaxed give no response and but a slight one when partially relaxed. Miss Miller (**55**) working under Jacobson found that relaxation reduced the extent of movement, the reaction time, and the apparent intensity of stimulus. The attitude of the worker, his general physiological condition and monotony, entering into many types of work would probably produce relaxation. On the other hand a muscular tenseness and continual overalertness makes rapidly for fatigue (which is, of course, distinct from, though it may be associated with, relaxation).

Any strained intensity would certainly be associated with an emotional condition. Interest, physical well being and emotional poise are, therefore, essential to occupations requiring accurate responses under varying conditions.

Distractors. Evans (15) found that distractors lengthened reaction time most at first, but always some. Thus habituation cannot entirely eliminate their effect. There were found, however, large individual differences, some subjects concentrating on the stimulus, others being affected by the surroundings.

Evans found also that distractors affected stimuli of the same mode most; that sound was the most effective distractor, light less so, and touch least. Thus a street car operator would be affected by the numerous sounds which surround him when he reacted to an auditory stimulus such as the rumble of an approaching truck. Of more importance, however, would be the effect of surrounding visual stimuli, on, for instance, the perception and reaction to automobiles coming out of side streets.

Cassel and Dallenbach (7) found that intermittent distractors were the most disturbing. During the day car operators find greatest intermittence in auditory stimuli. The noises on a street are highly varied both in intensity and in temporal quality.

Jenkins (46) found that the summation effect due to changes in extraneous stimuli is in proportion to the degree of adjustment of the subject to the definite stimulus. Although surrounding stimuli are changing, the operator can become so adjusted to reacting to the traffic movements which are significant to him that he will not be distracted by sounds and sights which mean nothing to his work. Knowing that these distractions do exist and that they have been proved to lengthen reaction times, training might be carefully directed to helping motormen, especially those who are easily distracted, to overcome this difficulty. As it is, however, probably in most cases conditioned by "complexes," training could be only partially successful.

Attitude of the Worker. This factor is closely related to both of the above factors and to attention. If a passive attitude is dominant, Cassel and Dallenbach (7) maintain that the sensory reaction is constant; but if an active attitude is maintained, the sensory reaction is slow and varied. The worker could probably be trained in many instances at least, to maintain an attitude toward routine duties and emergencies which would parallel the passive attitude of Cassel and Dallenbach, if such an attitude is not native to him.

Mode of Stimuli. There has been considerable work done on reaction time to onset and regression of different stimuli, particularly to visual and to auditory. Jenkins (46) experimenting with light and sound found that reaction time was longer for onset of light and

for regression of sound, and shorter for regression of light and onset of sound. Woodrow (91) found reaction times shorter the greater the darkening using irregular preparatory intervals. There seems to be some agreement in the conclusion that reaction time to onset of sound is shorter than that to light. Wells (88) believes the slower reaction time to visual stimuli is due to the slowness of the photochemical action in the retina.

Affect of surrounding conditions must be considered. Jenkins (46) found that reaction times were longer in unbroken quiet than in unbroken sound. We seldom meet either condition on the street but we do find them closely approximating it in the early morning and in the rush hours. H. E. Burtt (5) found that reaction times were quicker under nonuniform lighting than under uniform in an experiment controlled in such a way that the difference in reaction times was not due to greater alertness for expected emergency. Johnson (47) found greater variability in reaction time in very dark or excessively bright surroundings than in moderately light ones. Street lighting we find nonuniform and moderately intense.

Work on duration of stimulus and its effect upon reaction times was done by Froeberg (27) who found that lessening duration of visual or auditory stimulus produces arithmetic increments in reaction time. On the street the duration of stimulus cannot be controlled. There are important individual differences in this factor and ones which would be valuable in diagnosis.

Poffenberger (63) found an increase in reaction time with separation of stimulated area from the fovea. He also found reaction times increased more rapidly when visual angle was on the temporal side than when on the nasal. This is very important in street car operator's work for much of the traffic is on one side and he must see it at a comparatively great angle.

Wells (88) found that reaction time varied inversely as the intensity of the stimulus. Thus a stimulus must be of sufficient intensity and in the direct line of vision to be reacted to with the greatest efficiency.

Holmes (40) concluded that time of reaction is not a function of wave length so no allowance need be made for reactions to different colored lights. This would hardly be true of the outer regions of the periphery. (But see above paragraphs 1 and 2 under Color in Vision.)

Reaction time is thus found to be dependent upon (1) duration of stimulus, (2) visual angle, (3) intensity of stimulus, (4) nature of

surrounding conditions, (5) mode of stimulus, and (6) mental and physical condition of the individual.

Fatigue

Objective. A conditioning factor of reaction time and attention as well as of sensory responses is fatigue. Physiologically it has always been assumed that there was some kind of toxin produced which causes fatigue. This theory has been recently attacked. In a fatigued condition there is an increase in circulation (Manzer (52)) and in the rate of metabolism. There is also some endocrine secretion. Exact data on all this is, however, missing and further investigation along these lines is desirable. Cordero (10) found that the curve of carbon dioxide tension in alveolar air during recovery from a short period of vigorous muscular exercise is concave downward and just the inverse of curves of lactic acid disappearance from the blood and the disappearance of the oxygen debt. The recent theories thus emphasize the production of carbon dioxide and lactic acid in the body. Myers (12) considered monotony to be the danger signal of central nervous system exhaustion. If this is so, it must be some interaction between the nerves at the brain center with the specific muscles nerves for it has been shown that the muscles are specifically fatigued.

We find considerable disagreement between the results obtained in the experiments on auditory fatigue between Flugel (24) and Pattie (60). Pattie's work was done some four years later than Flugel's but we find Flugel's technique sound. Auditory fatigue according to Pattie is the diminution of intensity of stimulating tone and of tones subsequently heard caused by prolonged stimulation of auditory mechanism. He has figured out the exact decrease to be 1 difference limen plus when stimulating tone is 1 minute in duration and of energy 75–100 sensations unit of Western Electric audiometer. They agree that the duration of stimulus is a factor in fatgue. Flugel, however, found that the intensity was not a factor and Pattie believes that it is. Flugel also maintains that fatigue is specific for tones of different pitch and Pattie finds that it is nonspecific in this respect. These men agree that this fatigue is unaffected by distraction. Flugel experimented by introducing louder sounds. The factors then which they agree on are, fatigue is affected by duration of stimulus and unaffected by distraction.

Continuous binaural stimulation does not affect localization, but uniaural stimulation introduces fatigue of that ear and produces an

apparent displacement of the tone to the unfatigued side (Flugel) and a fading of tone more quickly on fatigued than on unfatigued side. This fatigue he found to be of short duration. This fatigue and localization is of great importance in many industries. The street car operator for instance whose auditory mechanism must be greatly fatigued a good share of the time would find difficulty in ascertaining just how near the noise was or its exact location.

Halverson (33) has recently done some interesting work on the localization of sound under normal not fatigued conditions. It was already known that high tones above 800 d.v. were localized with difficulty. Halverson found that localization to right and left was impossible only at the upper limits of hearing. With change of phase, tones of high frequency move over a more limited area than do low tones and a greater lateral displacement occurs if tones are in motion. Fatigue in localization of very high frequencies occurs rapidly, so we have another factor for fatigue added to Flugel's duration and Pattie's intensity. Halverson divided frequency into three groups, one of frequencies below 1,400 d.v. where there was consistent judgment of direction; one between 1,400–3,000 d.v. where localization was not difficult if fatigue was accounted for; and the third, those above 3,000 d.v., where lateral localization was observable but median localization was extremely difficult. The motorman is called upon for lateral localization almost entirely and he should be able to do this according to Halverson. Very rarely would the worker be confronted with tones at the upper limits of hearing but in very many cases he would have to deal with high frequency tones. The street car operator will find them in the noise of heavy traffic and the repeated toots of automobile horns.

Phillips (62) found that fatigue is caused generally but that it is transferred specifically. That is to say, any mental or bodily exertion causes fatigue, but the extent to which this fatigue affects any subsequent exertion is determined by the nature of that exertion. Thus the only remedy for fatigue is rest—it is not change of occupation.

Small muscle groups recover more quickly than the body as a whole (52). Crawley (11) believes that recovery of the arm is greater than that of the leg. In his experiment more work was accomplished in a period following heavy weight lifting than light, but if the same quantitative amount of work was done, that is, as many heavy weights as light weights were lifted, more work was done in the period following light weight lifting. An operator exercises

small muscle groups in use of hands and feet, there are few operations that call for the use of the body as a whole. The control handles although fairly stiff would probably be considered light weight lifting. Thus we would not expect to find excessive fatigue caused by these factors.

Spiller (**78**) found that reflexes were exaggerated by fatigue, but disappeared with excessive fatigue. Considering the work of Rivers and Head (**35**) done on the systems of afferent nerves, it seems that in the fatigue such as that which Spiller produced, the epicritic nerves probably do not respond to stimulation any longer and the protopathic only are stimulated. This would mean then that the finer stimuli are not responded to at all, but that the larger stimuli are responded to by the deeper nerve system uncontrolled by the fine discrimination of the epicritic system. In excessive fatigue, both systems will no longer respond and no impulses are sent to the nerve center. This must be subject to individual differences in nervous tension and relaxation. Manzer (**52**) finds that muscles recover very rapidly when work done is of short duration so that rest pauses should be fairly frequent. According to his experiments more work is done after a rest pause than before. So many factors other than fatigue condition this in industry that it could scarcely be considered except in particular cases or in certain operations. Very little advantage is gained, however, by urging men to greater effort through some incentive, for the period of recovery then necessary is relatively longer, and on the whole less work may be done.

The rest pause should be long enough to dissipate fatigue (Phillips (**62**)) but not so long that the incentive for the work has also disappeared. (Manzer (**52**) finds that on the average and within certain limits the recovery value of the rest pause is directly proportional to length of rest pauses. Rest pauses should be considered in series and not as one or two with long work periods. At the end of each trip the operator is allowed so much time to "lay over" or more technically speaking a rest pause. This averages about one-twelfth of his running time and occurs about every hour. If he is late in finishing his trip, he must start back on time, his rest period being cut short to that extent. Generally, however, the time allowed for rest at the end of a trip is fully adequate.

Subjective. Besides conditions of objective fatigue, we find subjective fatigue playing a large part in inefficiency. Weinland (**87**) found increasing variability in output with increase in fatigue. He believed this to be due to loss of control rather than to the exhaustion

of the muscle. He found that individual differences were greater at low output but that the variability for the work curve of a given individual for a given task remained comparatively constant. There was more time spent in rest pauses as time goes on. Probably the operator is more liable to subjective than to objective fatigue. His work as has been stated is not very strenuous physically and his rest pauses are frequent, but his work does become monotonous. There would tend to be great variations in his work curve due to loss of control. Any great oscillation of this kind is extremely dangerous for emergencies are as apt to arise in a drop as in a rise of energy. Since this variability is general, a knowledge of its extent in individual operators would be very valuable.

Vernon (**83**) did some experiments on long spells of repetitive work (no muscular work) but his results were inconclusive due to the great variations between individuals and in the same individual. There seemed to be some relation between inaccuracy and boredom. He concluded that some people were unsuited to repetitive work because of their variability in performance, their liability to boredom, and probable liability to accidents. Spencer (**77**) found that monotony in fatigue caused longer reaction times.

Davies (**12**) considers the attitude of the worker in relation to monotony. It is as we know the element of interest or rather the lack of it which changes monotony to fatigue. Not only conditions of work but the personal relations and the individual's attitude toward the work and the group conditions the interest. One discontented individual will cause a perfectly normal group of workers to be discontented and introduce monotony in the operation for the entire force. Davies finds that an increased continuity of work does not mean greater output and those people subject to monotony show definite initial and end spurts in their work curve. He also warns us in the case of repetitive mechanical and automatic operation, due to the fact that the mind does not have to be kept on the work, against opportunity for revery. If the worker's mind is occupied he will not think of dissatisfaction or imaginary dangers incurred in his work. Many cases of psychoneurotic breakdown among workers have been traced to this cause.

Summary. Objective fatigue results in a certain physiological condition, which involves the production of carbon dioxide, lactic acid, and exhaustion of the nerves. In a consideration of auditory sensations, fatigue was induced by duration of stimulus, but not by distractions. Localization of sound was affected by uniaural fatigue

and produced most quickly at upper limits of hearing. Since fatigue is transferred specifically, rest pauses must be introduced. These rest pauses are in direct proportion to the work accomplished and should be frequent and of sufficient length.

Subjective fatigue is due to loss of control rather than to muscle exhaustion and produces great variability in the individual's work curve. It is related to boredom, monotony, and dissatisfaction. This type of fatigue quickly renders a worker liable to accidents and makes him unfit for safe street car operation.

Attention

The law of attention is formulated as follows by Spearman: "Every mind tends to keep its total simultaneous output constant in quantity howevery varying in quality" (74). This constant amount of quantity may be directed to one thing which would then receive the person's entire attention or it may be distributed among many things in which case each would receive a small portion of attention. These aspects, the intensive and extensive distribution of attention are important to the operator's work since he must attend to many objects in traffic and not divert too much attention in one way so that he fails to take precaution in another. McQueen (54) in his work found that the ability to distribute attention was specific and not general. He used different sets of tests and found that the same observer differed in his ability to distribute his attention in each one.

Although it seems that the attentive ability of an operator need not be of the highest, it is very important that it should never fall below minimum requirements. It is quite certain that attention does oscillate considerably (75) and it is undoubtedly true that emergencies arising in a low wave of attention are not met which could ordinarily be dealt with satisfactorily. Rhythms of attention Griffits and Gordon (31) attribute to vasomotor accompaniments of changes of attention and to the motor changes accompanying these changes. Oscillation is the most important factor in the analysis of attention needed in car operation.

Woodrow (90) found mode of stimulus conditioned attention. Touch stimulated to the highest degree, sound next, and light least. The same experimenter concludes that definiteness of outline of object is a condition of attention. It would depend subjectively upon visual acuity. This effect of definiteness of outline upon clearness decreases with increase in absolute difference between intensity of stimulus and background, and with increase in size of change. Objects

on street are often very blurred and the outlines are faint. Does this condition attention and explain why they are not perceived?

Guilford (32) believes that fluctuations of attention to weak visual stimuli are influenced by the following physiological factors, local retinal adaptation, eye movements, and local central fatigue or inhibition. He concludes that length of periods of visibility and of invisibility and the total period is a function not of attention but of the intensity of stimulus.

Tinker (81) working on relations between distracted motor performances and performance in an intelligence test found that an intended distractor might reinforce sensory impressions and manual precision of movement. Jacobson (44) worked with sound and pressure stimuli on the theory that the distraction of attention consisted in the inhibitory influence of one sensation upon another. The effect of distractors must be subject to great individual differences as well as to fatigue and practice.

Thus in car operation consideration must be given to the following factors: (a) amount of energy, (b) oscillation, (c) distribution, and (d) the effect of distractors. While as a result of psychological experimental work some general principles have been evolved regarding (a) and (b), the suggested specificity of (c) and (d) makes the problem of determining attentive ability rather an intricate one.

Kinaesthetics

The mechanical operation of a car consists of moving control handles which operate power, brake, doors, etc. They must be moved a certain distance or over a certain number of notches for each speed, degree of braking, etc. After the training period the operator must judge these distances without looking at the handles and do it without consciously thinking of it. For instance when he realizes that there is a dangerous situation immediately ahead of him, he must not have to think about how far he has to move the control handles. He must perform this operation absolutely automatically. To do this he must judge the distance necessary to move his arm by the use of some so-called kineasthetic image. Each individual must differ markedly in the way he judges distances by kinaesthetic impressions. Weber (86) found that load affects apparent distance in direct proportion but at the critical point increase in load increases accuracy.

Fernberger (16) and later Rudishill (68) found that weights could be judged by (1) pressure sensations on finger tips, (2)

kineasthetic sensations in wrist, or (3) by relative intensities of weights. The method chosen would seem to depend upon the attitude of the observer. Fernberger found that coefficients of precision for psychometric functions of all judgments were similar for all three attitudes and that sizes of intervals of uncertainty varied.

Holland (39) in an attempt to clear up former discrepancies in results which he believed due to differences in the observer's attitude found that, if the observer assumed a passive attitude, the duration of the primary sensation was very brief (.75–2.0 seconds) with few and brief after sensations. If the observer assumed an active attitude the duration of primary sensations was much longer (as high as 200 seconds) followed by numerous after experiences of long duration with a tendency to perceptual construction. Here again a passive attitude seems more desirable in the worker. Too long a duration of the sensation and too great after experience would greatly impair the accuracy of response in ensuing action. In an emergency the worker must often pass rapidly to another sensory response, which any interference effect should not affect.

In addition to kinaesthetic sensations in arms by using control levers, there are kinaesthetic sensations of body movements especially in the feet and legs. The operator must learn the sway of his car with pressure on feet and legs in order to make correct application of brakes, to judge his speed, and so on. This is illustrated in his use of the brake in coming to a regular stop. In order to stop in just the correct place and to stop smoothly, to start smoothly keeping the car absolutely under control, to judge distance and speed when turning curves, to know how much to slow down for intersections and congested streets, the operator must judge to a fine degree the kinaesthetics of pressure and sway which he receives. His ability to receive and to respond to these sensations determine the accuracy and smoothness of his operation. The experimental work in this field is somewhat inadequate, having been discouraged by the modern abandoning of the analytic approach.

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PSYCHOLOGY IN JUNIOR COLLEGES

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Since particularly in the West, and to an increasing extent in the Middle West and South, junior colleges are more and more absorbing the work of the first two college years, one may wonder what type of psychology is offered by this class of institution, especially since it is mostly in the sophomore year that students begin work in this field. The writer was able to examine the psychology offerings in 131 catalogues from 31 states, which were returned in response to form requests sent by Professor W. C. Eells of the Education Department of Stanford University to all listed junior colleges in the country.

Of these 131, 117 gave one or more courses in psychology, there being a total of 204 courses. They may be classified as follows:

86 General, or Introductory.
55 Educational.
26 Child, or Adolescence.
10 Applied, Business, or Vocational.
7 Social.
5 Special applications to school subjects.
2 Advanced.
2 Tests, Intelligence or Mental.
2 Experimental.
2 Rational.
1 Empirical.
1 Abnormal.
1 Not named, probably General.

Many of the general courses were obviously educational in character, judging by description of aims and contents. Even granting that these colleges do not go beyond second year, work in many lines is slighted, particularly experimental and tests. These courses are no more advanced than child or applied, which are frequently offered. The teacher's training type of work is obviously overemphasized. Examining the contents of the courses as outlined by the catalogues, by far the greatest majority seem inadequate. However, judgment from description alone is unsafe.

Departments giving courses in psychology are as follows:

35 are separate.
34 are given by the Education Department.
12 have a joint department of Education and Psychology.
9 are under Philosophy.
7 are under Philosophy and Psychology combined.
14 more are miscellaneously classified, such as Social Sciences, Sociology, Logic, Physiology.

Even where the department is ostensibly separate, the faculty member may often be teaching some other subject in addition to psychology. In respect to departments the educational influence is again seen to be emphasized.

Faculty members were listed in 55 cases: 6 have the Doctor's degree; 38 have an M.A.; 7 an A.B., and the other 4 are not classed as to academic antecedents. Only two are full members of the American Psychological Association, and one of these is listed by the junior college as a consultant rather than on the regular teaching staff. One more is an associate member, but is only on part-time work in the junior college. Inspection of the Psychological Index as far back as 1920 reveals only four articles produced by any of the faculty members, these being two each by the above mentioned members of the American Psychological Association. This instructional status is in marked contrast to that in many of the regular four year colleges, where in many cases the head of the department, often a leading figure in the field, conducts the beginning course. In only two or three junior colleges is there more than one faculty member giving courses in psychology. Less than half have one giving full time to the subject.

Texts used were mentioned very infrequently. Those named by three or more colleges were, in order, Woodworth, Pillsbury, Allport, and Warren. There were 19 more miscellaneous, some decidedly out of date, and others very obscure.

Although catalogues from less than half of the junior colleges in the country were available, and many of these gave incomplete information, it may be assumed that those examined were at least typical. In fact, it seems probable that they represented the better type of institution, and that where fairly complete information was given carefully worked out courses and more permanent faculty members could be assumed.

In general, the offerings of psychology in junior colleges appear rather poor, and with too much emphasis on the educational aspect of the field.

KEILLER, W., *Nerve Tracts of the Brain and Cord.* New York: Macmillan Company, 1927. Pp. 456.

This work by a professor of anatomy in the University of Texas aims to present the anatomy, physiology, and clinical aspects of the central nervous system. The book is primarily intended for students and practitioners of medicine.

The volume is divided into three parts and a supplement. Part I is a laboratory manual for the study of the tracts and anatomical peculiarities of the central nervous system. Part II presents lectures given by the author on the anatomy and physiology of the nerve tracts, largely based upon autopsy findings. Part III consists in a presentation of the leading features of the better known nervous diseases as they are exemplified in symptomatology, anatomy, and pathological data.

The author acknowledges his indebtedness principally to Cunningham, Dejerine, Church, Peterson, and articles in *Brain* and the *Revue Neurologique*. Throughout the work there are very few references to source material. The student will find the book useless as an introduction to the special literature of any subject. At the end of the volume are given 225 drawings and cuts, many of them of great value. There is one long cut inserted in the volume which shows diagrammatically the tracts of the central nervous system as they appear at thirteen levels, from the cord to the cortex.

There is little new material in the book and much recent experimental literature is neglected. This is particularly true in regard to question of brain localization. The work of Henry Head is accepted in an uncritical manner. Throughout the volume there are many statements which are open to question from the standpoint of scientific psychology. For example, there are a number of references to what the author terms the "compass sense" and the "tuning-fork sense." In regard to the "silent areas" of the cortex the author says: "Presumably they are occupied in the storing up of cell memories either motor or sensory, the linking together of such memories to form abstract ideas. . . ." Again, he writes of aspects of movement that are "initiated by the will by means of the left side of the brain."

The book may prove valuable for those whose primary interest in the nervous system is that of the practicing physician.

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JONES, F. W., and PORTEUS, S. D., *The Matrix of the Mind.* Honolulu, T. H.: University Press Assn., 1928. Pp. 457.

This volume is intended to correlate certain aspects of biology and psychology. It may be regarded as the first result of a grant made by the Rockefeller Foundation to the University of Honolulu for the purpose of furthering research in the biological sciences.

The book is divided into two parts. Part I is primarily devoted to a consideration of the biological basis of mental life. Part II considers the evolution and nature of behavior.

The first chapters of the work are devoted to a treatment of the development of the response mechanism. In some respects, this presentation is novel. The thesis is advanced that beauty is more than skin deep. It is suggested that the gay color of a bird is really represented in its nervous system. Likewise, the grayness of a mouse finds its counterpart in the neurology and behavior of that organism. In man, likewise, surface appearance, even as it expresses itself in clothing or tattooing, is held to have a fundamental biological basis. In the consideration of the development of the brain, the principle of neurobiotaxis is described. Development is considered as a preparation for future action. The authors assert that we must not forget that the eyelids in the embryo open and close, close and open again, not because light rays reach them, but because one day light rays will fall upon them. No satisfactory explanation is given, however, of the mechanism by means of which such future events influence the present. The localization view of the cortex is given without reference to the recent experimental findings which tend to throw doubt upon the older view of localization. Awareness is held to be a definite function of the pallium. It is the contention of the book that the frontal areas of the cortex are related to social conduct. The evidence for this phrenological deduction is not convincing.

In the second portion of the work, behavior is considered in a genetic form. From ameba to man it is held that nothing entirely new in quality has been added in phylogeny. Consciousness is asserted to be a "sense of aliveness."

The volume is an interesting and significant effort to work out the relationship between certain aspects of biology and psychology.

Mechanically, a number of errors have crept into the printing of the book.

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SPROWLS, JESSE W., *Social Psychology Interpreted.* Baltimore: Williams & Wilkins, 1927. Pp. xii+268.

The opening chapters deal with the origin and nature of social psychology. It is pointed out that from the standpoint of scientific premise "social phenomena may be studied systematically in terms of closed systems of related facts." Thus, a group psychology developed out of a study of cultural products and interrelations of groups may be as consistent as a social psychology developed out of a concept of interindividual stimulus and response.

There follow a number of chapters dealing first with a review of the seemingly perennial matter of instincts. The author indicates the different concepts of instinct ranging from the animal behaviorists with their emphasis upon the purely reflexive aspect, resting upon single but fundamental structures, to the school of teleologists who look upon instincts as "springs of action." He points out further that "experimental evidence has tended in recent years to show that the term habit is actually a more factual expression of behavior descriptions." Moreover, "higher and lower mental processes are not strictly separable in function," so that the old-fashioned separation of instinct from reason is largely fallacious in view of our present knowledge. Hence, recent attempts to account for motives in pedagogy, industry, and social life on the grounds of instincts are as faulty as the older rationalistic or utilitarian interpretations. The chapter of social forces indicates the wide use made of the term and exposes its limitations in revealing fundamental causal relations among social phenomena. It is, at best, a descriptive term of certain "sequential" configurations.

The chapter on group mind theories shows first that the idea has a faulty basis in its philosophic premises and in the psychology of so-called group behavior, especially in the particularistic notion "that social behavior owes its origin and characteristics to causes external to the individual." Sprowls, however, in criticizing the idea warns us not, on the other hand, to fall into an equally bad fallacy of mere individual stimulus and response. Individuals do respond in groups and even the term "'ground mind' may be employed for descriptive purposes."

The author, then, takes up an analysis of types of social organizations drawing examples from various sources. Social organizations seem to rest upon a certain "coherency of individual habits and interests" rather than upon instincts as McDougall holds. The dynamic, changing nature of social organization must always be taken into account whenever we try to relate the individual to it either in description or in interpretation.

The next section really deals with what might be called group psychology rather than social psychology in the narrow sense. Two chapters are given over to treating the relation of culture to social behavior. Cultural anthropology has made marked impressions on some social psychological writing, especially in the work of Kantor, DeLaguna and others. Culture patterns may be thought of as "accumulated modes of group thought and behavior in the presence of familiar aspects of environment" and must be taken into account in social psychological analysis. In the discussion of conflict of cultures the author raises the important point as to whether social psychology as a science may and should consider cultural products as among its fundamental categories. Certainly these demand attention in any psychological consideration of group life as a unit, that is, in group psychology. Two chapters expose the psychology of group conflicts as illustrated by war and by such mass movements as speculation manias and the millenialisms among certain historical peoples.

The author then turns back to social psychology in the more narrow meaning dealing with social interaction or interpersonal relations. Interaction concerns some purpose involving values, and takes place at the strictly psychological level in the field of imagery and judgment, although the reviewer would consider the value aspect as raising a fundamental problem of meaning in the social situation.

The chapter on methods indicates how subject-matter and method are interrelated. For social psychology, the division into group psychology, on the one hand, and into psychology of personal interaction, on the other, raises naturally some questions of methodology for the respective fields. In the first, the historical method is appropriate, in the second, the natural science method, especially the use of statistical technique, is recommended.

The chapter on the laws of social psychology does not state them, since we are not yet ready for any thoroughgoing conceptualization, but it does raise the issues of just how these laws may be worked out from the various methods. The final chapter offers conclusions and

interpretations. Simple, one-track explanations must give way to a more complete picture of interindividual stimulus and response, to a better comprehension of dynamic, changing situational configurations, to a recognition of the fact that social psychology, to offer at all a consistent unity as a science, must take into account both the interindividual and the cultural factors.

"This volume is intended for students who are beginning the study of social psychology" says the author in the opening sentence of his preface. The beginner, then, will be introduced not into concrete analysis of social psychological phenomena, but rather into discussions of what social psychology is about. This is pedagogically unsound and leaves the student with some knowledge of various theories and points of view but with no technique for analyzing situations nor any information about the meaning of social behavior of individuals. The book is really for the advanced student who is already familiar with a wide range of material scattered over the fields of psychology, anthropology and sociology. Thus, while the book is not to be recommended as an elementary text, it does have considerable value in the theoretical reconstruction of social psychology and it ought to assume a place among the current books of philosophical and psycho-sociological nature which attempt to do this.

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GATES, GEORGINA STRICKLAND, *The Modern Cat: Her Mind and Manners.* An Introduction to Comparative Psychology. New York: Macmillan, 1928. Pp. ix+196.

This book is interesting and informative, but as an introduction to comparative psychology, which its subtitle proclaims it to be, is unsatisfactory. The paucity of psychological work upon cats, and too often its inferiority, make the cat a peculiarly inappropriate vehicle for a presentation of the methods of comparative psychology. Much more and better work has been done upon primates, especially chimpanzees, and upon rodents, especially rats. It is regrettable that the cat has been so neglected, for it is an excellent subject, a good representative of the carnivores, and of peculiar strategic value for the application both of the mass production methods commonly employed with rodents, and of the individual methods generally used with primates.

The author omits little of psychological importance in the cat literature. The work of Drescher and Trendelenburg is probably too

recent to be incorporated, and would not materially alter the story in any case. This is not true, however, of Teyrovsky's five papers, and they, while perhaps not in themselves conclusive, would suggest at least a revaluation of earlier work. It is unfortunate also that the author did not take advantage of this opportunity to rescue from their ill-deserved oblivion the extensive and interesting observations of Perez on the behavioral development of two kittens from birth through several months.

However, it is not the omissions, but the evaluation of the work included, with which this reviewer would take issue. The whole tradition of "random movements" and "gradual elimination" of useless ones, is here set forth as the type of cat learning, without any criticism of the technique, description or logic upon which this tradition is based. The time curves of Thorndike are accepted without question as adequately representing the progress of the learning in the puzzle boxes. Moreover, according to the author, "The cat curves are gradual, there are no sudden and sharp descents which materially affect the subsequent course of the curves." The two curves that are reproduced are two that agree with the foregoing quotation, in spite of the fact that many—perhaps most—of Thornlike's curves *do* show sudden and sharp descents with maintenance of the low level. It is an interesting commentary on the strength of the tradition that most textbook and other writers who reproduce any of Thorndike's curves, select those that agree with the tradition rather than those that contradict it. None would question the importance of Thorndike's influence in comparative psychology and it is not the reviewer's task here to attempt an evaluation of his conclusions, but he is compelled to note that no account is taken in the present work of even the commonplace criticisms of those conclusions.

The chapter on "The Experimental Method" is entirely Thorndike's experimental method. Hobhouse's experiments on cats, which in spite of their varied procedure and fragmentary description give a more accurate account of normal cat behavior than do Thorndike's, are practically ignored. Thorndike's imitation experiments are regarded as more conclusive than Berry's. As is customary in the tradition, the best parts of Thorndike's work are discarded, and emphasis and approval placed upon the worst.

The concluding chapter, on "The Mind of the Cat," is naturally somewhat dogmatic. It considers, for example, that cats have been "shown" to be incapable of hearing tones. There is a chapter of cat

anecdotes, duly criticized and reinterpreted in later chapters, and chapters on the cat's instinctive behavior, sense organs and emotions.

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FOUCAULT, MARCEL, *Cours de Psychologie.* Paris: Alcan, 1928. Pp. 502 (2 vols.).

This work is apparently intended as a textbook for elementary students. The author attacks the whole subject from the historical point of view, taking up the various problems in chronological order. To students of philosophy, this historical development is very fascinating inasmuch as it presents the evolution of mind and thought. But to students of science, this method of approach would seem to fail to elicit spontaneous attention—very much needed in beginner's textbooks.

In the first volume, entitled "A Philosophical Introduction to Psychology," the author presents his material in seven chapters. The first chapter describes the various forms of psychology; namely, practical, literary, speculative, metaphysical, and scientific psychology—a very unique and interesting treatment. Then follows a chapter on the object of psychology, which states that the " domaine " of mental life involves the conscious, as well as the subconscious activities of the mind. The third section, dealing with methods of psychology, discusses, in detailed fashion, subjective and objective observation, psychological experimentation, and psychophysical measurements. Chapter 4 gives the author's division of the whole subject into four fields as follows: Adult Psychology, Abnormal Psychology, Child Psychology, and Animal Psychology. The next chapter takes up the so-called psychological laws, reviewing the pro's and con's of determinism. The author expresses his belief in a limited determinism, stating that " it is not sufficient to include the liberty of the causes." The last two chapters take up the problems of psychological analysis and of the kinds of psychological laws (including the laws of " composition," of causality, and of finality).

The second volume, " The Elementary Sensations," is a systematic treatment of the generally accepted sensations, which the author classifies according to the traditional categories of the introspectionists. Foucault admits the impossibility of directly observing an elementary sensation, but believes that one can observe phenomena

connected with sensations, and can thereby discover the certain essential characteristics. The kinesthetic and cutaneous sensations are very fully discussed. In each case, the descriptions of the organs and the theories concerning the sensations in hand are given. The author devotes about one-third of the volume to the visual, auditory, gustatory, and olfactory sensations, offering no new theories or interpretations.

As a whole, the work is a detailed review of the problems of systematic psychology. It does not present the viewpoints of the different schools, which are at present trying to break away from the old philosophical concepts and to place psychology on a scientific basis. A reader of this text seems to gain the erroneous impression that the science under discussion is quite an exact one. In other words, the author appears to have overlooked the need for further experimental work before definite conclusions are in order.

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ARTHUR I. GATES. *The Improvement of Reading, 1927.* New York: Macmillan. 440 pp., incl. appendices.

This book is concerned with the practical problems of improvement in the methods and materials of the teaching of reading, in the measurement of achievement, in the diagnosis of difficulties and failures, and in remedial instruction. It describes what is spoken of as a new procedure, the "intrinsic method" of teaching reading, and a new series of "diagnostic tests" of achievement in reading. A thorough study, such as this is, of any phase of human learning, should give some sidelights, illustrations, and results of general psychological interest. It is from this angle rather than that of its contributions to the technology of reading that the book is regarded in the present review.

The importance of reading for all scholastic achievement, the complexity of the process, and the difficulties of mastering the art are first stressed. A recent investigation finds that 99 per cent of the pupils who fail of promotion in the first grade and 90 per cent of failures in the second grade are marked as failures in reading,—doubtless because, whether rightly or wrongly, learning to read is the main business of these grades.

Striking examples of the relation of interest to achievement are cited. Interest is not the cause of the achievement but the degree of

interest is the result of achievement. Pupils fail not because of their lack of interest in reading, but they lack interest because they fail. So "in dealing with difficulties in reading we must attack the difficulty in learning as a means of reviving interest rather than attempt primarily to cultivate interest as a means of removing the difficulties." An occasional failure, however, persists because the pupil has become more distinguished "by being a failure than by being a success in reading."

"Intrinsic" methods rather than supplementary devices are advocated because they apply "our most trusty general principle of learning"—the establishment of particular reactions to particular situations. The road to reading is strewn with casualties due to the insufficient or disappointingly small *transfer* of the skills developed in the "flash card situations" and in the phonetic drill to the business at hand. The importance of not only making improvement possible but of measuring and "displaying" it is evidenced by the amazing "rebirth of zeal" as success is substituted for failure, and warrants a change in the adage regarding success to "nothing succeeds like observed success." The necessity of adjusting materials to abilities (as may be determined by tests), of the proper distribution of practice, of variety of attack, and of the simple but sadly vitiated precept of suiting the time to the task, *e.g.*, of not attempting to remedy what is perhaps the most serious of all school failures in an after-school hour,—these are matters amply illustrated in reading as in every other field of learning.

The variety of ways in which reading is acquired by children of equal intelligence furnish examples for the psychology of individual differences. The ways in which words are presented greatly influence the methods of perception adopted. Dependence upon certain striking characteristics, such as the "o" in "hot" or the curved tail of the "y" in "monkey"; or dependence upon the general configuration of a work; building up words from a study of the letters which comprise them; phonetic analyses of various kinds; syllabication; and dependence upon context; these are the principal methods, arranged in order of increasing complexity, which children use in studying and recognizing words.

Of particular importance are the chapters on the diagnosis of extreme reading disabilities and on the methods of teaching non-readers. The author remarks that physicians find such terms as congenital word blindness or alexia "convenient substitutes for real analysis of cases of reading disability" and that he has not yet

encountered "a case of disability which seemed to be best described as word blindness."

Certain minor features of psychological interest are the following:

"Other things being equal, words are harder to distinguish when they are of the same length."

In practice in "choice among similar words arranged in rows" it is found that distinctions are the more easily made from vertical than from horizontal columns.

For those who are slow readers, mainly because of the retardatory effect of unnecessarily elaborate articulatory activities of the speech organs, the most effective remedial treatment is to stimulate the child to faster reading and to inhibit and control superfluous muscular activities.

Word-games are valuable in that "so far as the arrangement of stimulus, response, and check is concerned, . . . the psychological principles of word-learning are properly utilized."

W. F. DEARBORN.

Harvard University.

J. J. VAN BIERVLIET. *La Psychologie d'aujourdhui.* Paris: Alcan, 1927. 152 pp.

Modern psychology is the title of this volume by a professor, presumably of psychology, at a Belgian university. The author proposes to describe the various aspects of mental life and the methods employed by psychologists in studying mental phenomena, and on the basis of such a description to touch upon certain philosophical considerations associated with the development of the science.

Having defined psychology as the science of mental or conscious life the author limits himself, in a section entitled *"Concerning the Genesis of Psychological Varieties,"* to a brief analysis of sensation, attention, memory, imagination and intelligence, interspersing his description with an attempt to indicate the influence of congenital endowment and of the changing environment upon these mental phenomena. A second section, *"Psychology and Psychologists,"* is somewhat in the nature of an apologia for the psychological methods of introspection, questionnaires, tests, scientific observation and psychophysical experimentation.

Perhaps it would be unjust to criticize van Biervliet's failure even to use the word behaviorism in a treatise entitled *"Psychology of*

To-day." It may be that this gospel has not yet penetrated the cloistered halls of the University of Gand. However, there is reason for vigorous objection to a discussion of sensation which makes individual differences in sensory type almost the sole basis for differences in accomplishments; to an analysis of memory which overlooks the findings of many careful investigations in this field; to a classification of intelligence into practical, aesthetic and scientific, and to many other unsupported generalizations of the same kind. The character of this work is well reflected in its reference to the psychological tests given to the Salvation Army of the United States; in the assertion that graphology and palmistry, although not yet sciences, are well on the road of attaining this status, and, more directly, in the fact that Fechner, Wundt, Binet, Janet and G. Dumas are the only psychologists to whose work reference is made in what is intended as a comprehensive survey of psychological methods and of psychologists.

MORRIS S. VITELES.

University of Pennsylvania.

A. E. HEATH. *How We Behave.* An Introduction to Psychology. London: Longmans, Green, 1927. Pp. vi+90.

This little volume, written for the Workers' Educational Association, is written in simple form. After discussing the field of scientific psychology the author seems to believe that the psychologist studies the "mental aspect of the organism." After finding Watsonian behaviorism an untenable position, the author discusses tropistic, reflex and instinctive behavior and plasticity at the higher levels. The little historical sketch,—which quotes only Aristotle, Descartes, Ward and McDougall indicates the philosophical nature of the discussion. The book closes with a discussion of personality; its innate background, the acquired portions consisting of skills and affective habits or sentiments. The chapter on the integration and disintegration of personality has strong psychoanalytic leanings. The reviewer would hardly recommend it as a first approach to psychology and, for anything else, it has little value.

S. W. FERNBERGER.

University of Pennsylvania.

JUNE E. DOWNEY. *The Kingdom of the Mind.* New York: Macmillan, 1927. Pp. x+207.

This little volume, written for the Young People's Shelf of Science, is done in a charming and entertaining manner. The chapters

develop the ideas of sensation, perception of space and time, memory, thinking and imagination and learning. One chapter is concerned with a self-inventory in which the importance of intelligence is emphasized but in which also it is pointed out that intelligence is not the whole story. The volume is written in a manner which should hold the attention of the intelligent child of high school age and is full of interesting and practical examples.

SAMUEL W. FERNBERGER.

University of Pennsylvania.

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NOTES AND NEWS

At the meeting of the American Psychological Association held in New York in December, 1928, it was voted to omit the annual meetings in December, 1929, and to merge these meetings with those of the Ninth International Congress of Psychology to be held in New Haven during the first week of September, 1929. At these meetings provision will be made for the Presidential Address of the American Psychological Association. At the Association meetings, the following elections were announced: President, K. S. Lashley, Institute for Juvenile Research, Chicago, Ill.; Secretary (1929–1931), Carl C. Brigham, Princeton University; Council of Directors (1929–1931), Albert P. Weiss, Ohio State University, and Herbert Woodrow, University of Illinois; Representatives to the Division of Anthropology and Psychology of the National Research Council, Samuel W. Fernberger, University of Pennsylvania, and Walter Miles, Stanford University; Representatives to the Social Science Research Council, Floyd H. Allport, Syracuse University.

At the recent meeting of the American Association for the Advancement of Science held in New York the following elections were announced: For Section I (Psychology), Vice-President, Madison Bentley, Cornell University; Secretary, Edward S. Robinson, Yale University; For Section Q (Education), Frank N. Freeman, University of Chicago; Secretary, W. L. Uhl, University of Washington.

The Psychological Bulletin announces with regret the resignation of Dr. Robert M. Ogden as Coöperating Editor, after twenty years of service. Professor John T. Metcalf, of the University of Vermont, has been appointed Coöperating Editor to succeed Professor Ogden. He will cover the fields of Sensation and Perception.